The documentation and process conversion measures necessary to comply with this revision shall be completed by 22 June 2002 .

INCH-POUND

MIL-PRF-19500/359F
22 March 2002
SUPERSEDING
MIL-PRF-19500/359E
16 August 2001

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, DIODE, SILICON, FAST RECOVERY, POWER RECTIFIER,
1N4942, 1N4944, 1N4946, 1N4947, AND 1N4948
JAN, JANTX, AND JANTXV

Inactive for new design after 27 February 1992
For new design use - 1N5615, 1N5617,
1N5619,1N5621, 1N5623 on
MIL-PRF-19500/429.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for a silicon, fast recovery semiconductor power rectifier diode for use in equipment circuits. Three levels of product assurance are provided for each device as specified in MIL-PRF-19500.

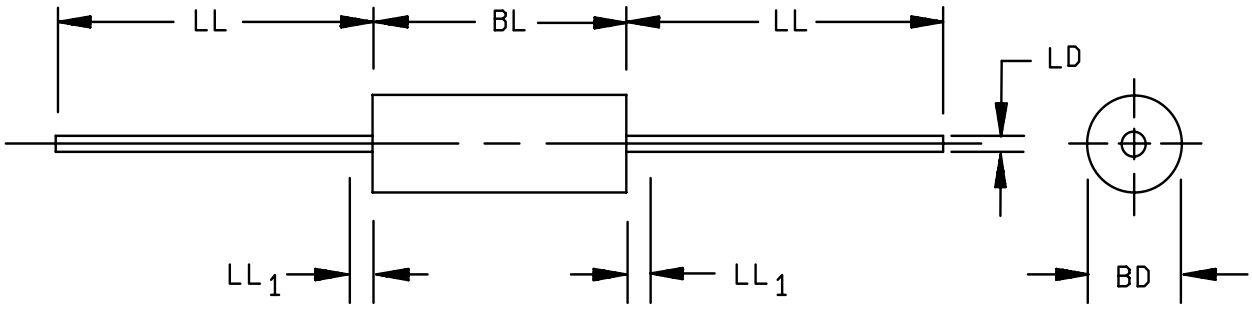
1.2 Physical dimensions. See figure 1 (similar to DO-41).

1.3 Maximum ratings.

Device type	V_{RWM} V_R	I_O (1) (2) T_A = +55°C	I_O (2) T_A = +100°C	I_{FSM} at t_p = 8.3 ms T_A = +100°C	Barometric pressure	t_{rr1} at I_F = 0.5 A, I_R = 1.0 A I_{REC} = 0.25 A	T_{STG} and T_{OP}
	V pk (V_{RWM}) V dc (V_R)	A dc	A dc	A pk	mm Hg	ns	°C
1N4942	200	1.0	.750	15		150	-65 to +175
1N4944	400	1.0	.750	15	8	150	-65 to +175
1N4946	600	1.0	.750	15	8	250	-65 to +175
1N4947	800	1.0	.750	15	33	250	-65 to +175
1N4948	1000	1.0	.750	15	33	500	-65 to +175

(1) Derate linearly from 1.0 A at T_A = +55°C to 0.75 A at +100°C. Derate linearly from 0.75 A to 0 A between +100°C and +175°C.
(2) No forced air nor heat sinking shall be permitted for I_O ratings at T_A = +55°C and +100°C.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43216-5000), by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.



Dimensions					
Ltr	Inches		Millimeters		Notes
	Min	Max	Min	Max	
BD	.065	.150	1.65	3.81	3, 4
BL	.140	.250	3.56	6.35	3
LD	.027	.033	0.69	0.84	
LL	1.00	1.50	25.4	38.1	
LL1		.050		1.27	5

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Dimension BL and BD include all components of the diode periphery except the section of leads over which the diameter is controlled.
4. Dimension BD shall be measured at the largest diameter.
5. Lead diameter not controlled in this zone to allow for flash, lead finish build-up, and minor irregularities other than slugs.

FIGURE 1. Physical dimensions.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

DEPARTMENT OF DEFENSE

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

STANDARD

DEPARTMENT OF DEFENSE

MIL-STD-750 - Test Methods for Semiconductor Devices.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Services (DAPS), Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 General. The requirements for acquiring the product described herein shall consist of this document and MIL-PRF-19500.

3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturer's list (QML) before contract award (see 4.2 and 6.3).

3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500 and as follows.

T_{CVF} ..... Temperature coefficient of forward voltage.

3.4 Interface and physical dimensions. Interface and physical dimensions shall be as specified in MIL-PRF-19500, and on figure 1 herein. All devices shall be metallurgically bonded-thermally matched-noncavity-double plug construction as defined in MIL-PRF-19500.

3.4.1 Encapsulant material. In addition to those categories of hermetically sealed package requirements specified in MIL-PRF-19500, fused metal oxide-to-metal shall also be acceptable.

3.4.2 Lead finish. Lead finish shall be solderable in accordance with MIL-PRF-19500, and as specified herein. Where a choice of lead finish is desired, it shall be specified in the acquisition document.

3.5 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.3.

3.6 Electrical test requirements. The electrical test requirements shall be group A as specified herein.

3.7 Marking. Marking shall be in accordance with MIL-PRF-19500.

3.7.1 Polarity. The polarity of all types shall be indicated with a contrasting color band to denote the cathode end.

3.8 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.2).

b. Screening (see 4.3).

c. Conformance inspection (see 4.4 and tables I, II, and III).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

4.3 Screening (JANTX and JANTXV levels). Screening shall be in accordance with table IV of MIL-PRF-19500, and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table IV of MIL-PRF-19500)	Measurement
	JANTX and JANTXV levels
9	Not applicable
11	I_{R1} and V_{FM1}
12	See 4.3.1 and 4.5.3
13	Subgroup 2 of table I herein: $\Delta I_{R1} \leq$ 100 percent of initial reading or ±50 nA dc whichever is greater. $\Delta V_{FM1} \leq$ +0.1 V dc, -0.2 V dc. Scope display evaluation (see 4.5.4).

* 4.3.1 Power burn-in conditions. Power burn-in conditions are as follows: T_A = +50°C max., see 4.5.3 and 4.5.3.1; $V_R = V_{RWM}$ rated (see 1.3); f = 50-60 Hz; I_O = 1.0 A dc.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-PRF-19500, and table I herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500. Electrical measurements (end-points) shall be in accordance with table I, group A, subgroup 2 herein. Delta requirement shall be in accordance with table III herein.

* 4.4.2.1 Group B inspection, table VIb (JAN, JANTX, and JANTXV of MIL-PRF-19500).

Subgroup	Method	Condition
B2	4066	I_{FSM} = rated (see 1.3); 10 surges of 8.3 ms each at 1-minute intervals; I_O = 0.75 A dc; V_{RSM} = 0.
B3	1027	I_O = 1.0 A dc minimum; f = 50-60 Hz; T_A = +50°C max.; V_R = rated V_{RWM} (see 1.3, 4.5.3, and 4.5.3.1); t = 340 hours.
B5	3101 or 4081	$R_{\theta JL}$ = 38°C/W; L = .375 inch (9.52 millimeters); I_M = 10 mA, t_{md} = 100 µs, I_h = 2 A, Th = thermal equilibrium.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VII of MIL-PRF-19500. Electrical measurements (end-points) shall be in accordance with table I, group A, subgroup 2 herein. Delta requirements shall be in accordance with table III herein.

* 4.4.3.1 Group C inspection, table VII of MIL-PRF-19500.

Subgroup	Method	Condition
C2	1056	Test condition A.
C2	2036	Tension: Test condition A, weight = 5 pounds; t = 15 seconds.
C2	1021	Omit initial conditioning.
C5		Not applicable.
C6	1026	T_A = +50°C max. f = 50-60 Hz; I_O = 1.0 A minimum; V_R = rated V_{RWM} (see 1.3, 4.5.3, and 4.5.3.1)

4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table IX of MIL-PRF-19500 and as specified in table II herein.

4.5 Methods of inspection. Methods of inspection shall be specified in the appropriate tables and as follows.

4.5.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

4.5.2 Inspection conditions. Unless otherwise specified, all inspections shall be conducted at an ambient temperature T_A of +25°C ±3°C.

4.5.3 Burn-in and life tests. These tests shall be conducted with a half-sine waveform of the specified peak voltage impressed across the diode in the reverse direction followed by a half-sine waveform of the specified average rectified current. The forward conduction angle of the rectified current shall be neither greater than 180 degrees, nor less than 150 degrees.

* 4.5.3.1 Mounting conditions. At the option of the manufacturer, any clips or heat sink mounting configurations may be utilized provided that I_O is increased such that the junction temperature of each diode is maintained at +135°C minimum for screening and +150°C for life test.

* 4.5.4 Scope display evaluation. Scope display evaluation shall be sharp and stable in accordance with method 4023 of MIL-STD-750. Scope display may be performed on ATE (automatic test equipment) for screening only with the approval of the qualifying activity. Scope display in group A shall be performed on a scope.

* 4.5.5 Peak reverse power test. This test shall be measured in the circuit of figure 2, or equivalent. A 20 microsecond half-sine waveform of current shall be used and peak reverse power shall be determined by the product of peak reverse voltage and peak reverse current.

TABLE I. Group A inspection .

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 1						
Visual and mechanical	2071					
Subgroup 2						
Forward voltage	4011	I_{FM1} = 1.0 A dc, pulsed (see 4.5.1).	V_{FM1}	0.6	1.3	V dc
Reverse current leakage	4016	V_R = rated V_{RWM}, (see 1.3), pulsed (see 4.5.1).	I_{R1}		1.0	µA
Breakdown voltage	4021	I_R = 50 µA, pulsed (see 4.5.1).	$V_{(BR)1}$			
1N4942				220		V dc
1N4944				440		V dc
1N4946				660		V dc
1N4947				880		V dc
1N4948				1100		V dc
Subgroup 3						
High temperature operation		T_A = +150°C				
Reverse current leakage	4016	V_R = rated V_{RWM} (see 1.3), pulsed (see 4.5.1).	I_{R2}		200	µA
Low temperature operation		T_A = -65°C				
Forward voltage	4011	I_{FM} = 1 A dc, pulsed (see 4.5.1).	V_{FM2}	0.6	1.5	V dc
Reverse current	4016	V_R = rated V_{RWM} (see 1.3); dc method.	I_{R3}		1.0	µA dc
Subgroup 4						
Forward recovery voltage	4026	I_F = 0.25 A; t_p = 20 ns, (minimum); t_r = 8 ns.	V_{fr}		5.0	V
Capacitance	4001	V_R = 12 V dc, f = 0.1 to 1 MHz.	C_J			
1N4942					45	pF
1N4944					35	pF
1N4946					25	pF
1N4947					20	pF
1N4948					15	pF

See footnote at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 4 - continued.						
Reverse recovery time	4031	Condition B1.	t_{rr1}			
1N4942					150	ns
1N4944					150	ns
1N4946					250	ns
1N4947					250	ns
1N4948					500	ns
Scope display	4023	Stable, see 4.5.4 n = 116, c = 0				
Subgroups 5, 6, and 7						
Not applicable						

1/ For sampling plan, see MIL-PRF-19500.

* TABLE II. Group E inspection (all quality levels) for qualification only. 1/

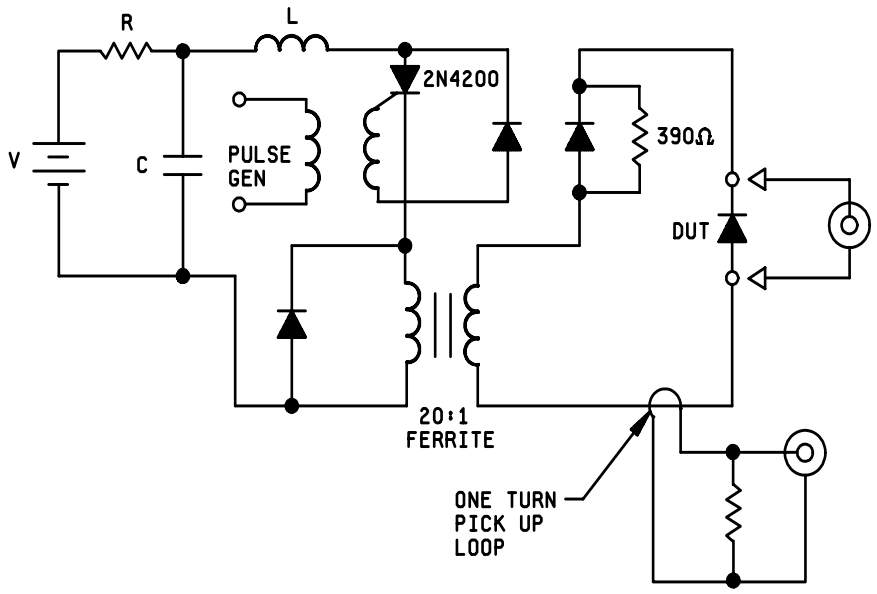
Inspection	MIL-STD-750		Sampling plan
	Method	Conditions	
Subgroup 1			22 devices c = 0
Thermal shock (temperature cycling)	1051	500 cycles, condition A.	
Electrical measurement		See table I, group A, subgroup 2.	
Subgroups 2 and 3			
Not applicable			
Subgroup 4			22 devices c = 0
Thermal resistance	3101 or 4081	$R_{\theta JL}$ = 38°C/W maximum; L = .375 inch (9.52 millimeters); I_M = 10 mA, t_{md} = 100 μs, I_h = 2 A, t_H = thermal equilibrium.	
Subgroup 5			22 devices c = 0
Barometric pressure (reduced)	1001	1N4944, 1N4946 = 8 mm Hg (100,000 ft); 1N4947, 1N4948 = 33 mm Hg (70,000 ft); Voltage during test = V_{RWM}; maximum; Leakage (I_R) during test shall be 5 μA.	
Subgroup 6			
Not applicable			
Subgroup 7			10 devices c = 0
Peak reverse power		See 4.5.5 and figure 2 herein. $P_{RM} \geq 500$ W. Test shall be performed on each sublot	
Electrical measurement		See table I, group A, subgroup 2.	

1/ For initial design and process change verification only (one time testing).

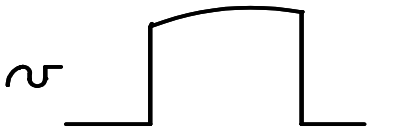
TABLE III. Groups B and C delta measurements. 1/ 2/ 3/

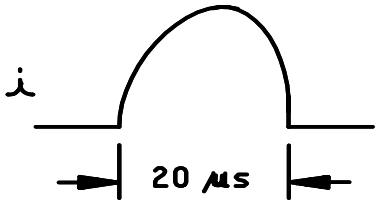
Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Forward voltage	4011	I_{FM1} = 1.0 A dc, pulsed (see 4.5.1).	ΔV_F	-0.2	+0.1	V dc
2.	Reverse current leakage	4016	V_R = rated V_{RWM} , (see 1.3), pulsed (see 4.5.1).	ΔI_R	100 percent of initial value or 50 nA, whichever is greater		

1/ Devices which exceed the group A limits for this test shall not be accepted.
2/ The electrical measurements for table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500 are as follows: Subgroup 3, see table III herein, step 2.
3/ The electrical measurements for table VII of MIL-PRF-19500 are as follows: Subgroup 2, see table III herein, steps 1 and 2.



NOTES:
1. L - 13T #22 pm 1 inch (25.4 mm) diameter form (air core).
2. C - 1 to 10 µf to give a 20 µs pulse width.
3. V - adjustable to 200 volts for power desired in D.U.T.





TYPICAL WAVE FORMS

* FIGURE 2. Peak reverse power measurement circuit and waveform.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. The acquisition requirements are as specified in MIL-PRF-19500.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers' List (QML) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center, Columbus, ATTN: DSCC/VQE, P.O. Box 3990, Columbus, OH 43216-5000.

6.4 Substitution information. Devices covered by this specification are substitutable for the manufacturer's and user's PIN (Part or Identifying Number). This information in no way implies that manufacturers' PIN’s are suitable as substitutes for the military PIN's.

6.5 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:
Army - CR
Navy - EC
Air Force - 11
DLA - CC

Review activities:
Army - AR, MI, SM
Navy - AS, MC
Air Force - 19, 70, 71, 99

Preparing activity:
DLA - CC

(Project 5961-2546)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

2. The submitter of this form must complete blocks 4, 5, 6, and 7.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-19500/359F	2. DOCUMENT DATE 22 March 2002

3. **DOCUMENT TITLE** SEMICONDUCTOR DEVICE, DIODE, SILICON, FAST RECOVERY, POWER RECTIFIER, 1N4942, 1N4944, 1N4946, 1N4947, AND 1N4948 JAN, JANTX, AND JANTXV

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) COMMERCIAL DSN FAX EMAIL	7. DATE SUBMITTED

8. PREPARING ACTIVITY

a. Point of Contact	b. TELEPHONE Commercial DSN FAX EMAIL 614-692-0510 850-0510 614-692-6939 alan.barone@dscc.dla.mil
c. ADDRESS Defense Supply Center Columbus, ATTN: DSCC-VAC P.O. Box 3990 Columbus, OH 43216-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman, Suite 2533 Fort Belvoir, VA 22060-6221 Telephone (703) 767-6888 DSN 427-6888